Docket No. 115-21-099 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Terry D. Beard

Serial No.: Unassigned

Filed: Herewith

Title: MULTICHANNEL SPECTRAL MAPPING AUDIO APPARATUS AND METHOD

Continuation of:

Serial No. 08/715,085 Examiner: V. Chang

Filed: September 19, 1996 Art Unit: 2747

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the above application, which is filed together with this amendment, as follows:

<u>In the Title</u>

Amend the title to read:

MULTICHANNEL SPECTRAL MAPPING AUDIO APPARATUS AND METHOD WITH DYNAMICALLY VARYING MAPPING COEFFICIENTS

<u>In the Specification</u>

Add the following paragraph at page 1, on the first line following the title:

<u>RELATED APPLICATION</u>

This is a continuation of application Serial No. 08/715,085, filed September 19, 1996 by the present inventor, entitled "Multichannel Spectral Mapping Audio Apparatus and Method".

In the Claims

Cancel claims 4, 22, 39, 56 and 69-85.

Amend claims 1, 10, 15, 18, 20, 27, 32, 36, 45, 49, 52, 54, 61, 65 and 67 to read as follows:

1. A method of conditioning an audio signal on a first set of channels to be reconfigured onto a second set of channels, comprising:

organizing said signal on said first set of channels into successive temporal aperture periods,

for each channel in said first set, establishing mapping coefficients for each of said aperture periods in the form of digitally encoded signals that vary among said aperture periods and map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

storing said audio signal on said first set of channels along with said mapping coefficient signals on a digital medium from which both the first set of channels and the coefficients can be read.

10. The method of claim 1, wherein the mapping coefficients for each of said first set of channels at any given time define a vector that allocates a distribution of at least a portion of the signal on said channel among the channels of the second set.

15. A method of reproducing on a second set of channels an audio signal present on a first set of channels, comprising:

organizing said signal on said first set of channels into successive temporal aperture periods,

providing said audio signal in digital format on said first set of channels along with a set of digitally formatted mapping coefficients for each of said aperture periods that vary among said aperture periods and, for each channel in said first set, map the audio signal level of said channel onto respective channels of said second set of channels,

reading said audio signal on said first set of channels and said coefficients, and

applying said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

18. The method of claim 15, wherein the mapping coefficients for each of said first set of channels at any given time are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, said coefficients are read from said digital medium in the form of said vectors, and the coefficients that are applied to said audio signal on said first set of channels to obtain the audio signal on said second set of channels are derived from said vectors.

20. A method of conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format of target channels, comprising:

organizing said signal on said source channels into successive temporal aperture periods,

dividing the signal on each source channel into multiple spectral bands,

establishing spectral mapping coefficients (SMCs)for each of said aperture periods that vary among

said aperture periods and, for each band of each source channel, map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel, and

storing said audio signal on said source channels along with said SMCs on a digital medium from which both the source channels and the SMCs can be read.

27. The method of claim 20, wherein said SMCs for each source channel at any given time define a vector that allocates a distribution of at least a portion of the audio signal on said channel among said target channels.

32. A method of reproducing on two or more target channels an audio signal present on monaural or stereo source channels, comprising:

organizing said signal on said source channels into successive temporal aperture periods,

providing said audio signal in digital format on said source channels along with a set of spectral mapping coefficients (SMCs) for each of said aperture periods that vary among said aperture periods and, for each band of each source channel, map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels,

reading said audio signal on said source channels and said SMCs, and

applying said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

34. The method of claim 32, for SMCs for each source channel that at any given time are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said SMCs are read from said digital medium in the form of said vectors, and the SMCs that are applied to said audio signal on said source channels to obtain the audio signal on said target channels are derived from said vectors.

36. An audio signal conditioning circuit for conditioning an audio signal on a first set of channels to be configured onto a second set of channels, comprising:

a signal processor that organizes an audio signal on said first set of channels into successive temporal aperture periods,

a mapping coefficient generating circuit that, for each channel in said first set, establishes mapping coefficients for each of said aperture periods in the form of digitally encoded signals that vary among said aperture periods and map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

a transfer circuit connected to apply said audio signal on said first set of channels along with said mapping coefficient signals to a digital medium.

45. The circuit of claim 36, wherein said coefficient generating circuit generates the coefficients for each of said first set of channels at any given time as a vector that allocates a distribution of at least a portion of the signal on said channel among the channels of the second

set.

49. A circuit for reproducing on a second set of channels an audio signal present on a first set of channels, comprising:

a receive circuit connected to read said audio signal organized into successive temporal aperture periods on said first set of channels along with a set of mapping coefficients for each of said aperture periods that, for each channel in said first set, vary among said aperture periods and map the audio signal level of said channel onto respective channels of said second set of channels, and

a decoding circuit connected to apply said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

52. The circuit of claim 49, for coefficients for each of said first set of channels in the form of respective vectors that at any given time allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, wherein said receive circuit is connected to read said coefficients in the form of said vectors, and said decoding circuit derives said coefficients from said vectors for application to said audio signal on said first set of channels.

54. An audio signal conditioning circuit for conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format having at least two target channels, comprising:

a spectral decomposition circuit connected to

divide the signal on each source channel into multiple spectral bands,

a signal processor that organizes the signals on said multiple spectral bands into successive temporal aperture periods, and

a spectral mapping coefficient (SMC) generating circuit that, for each band of each source channel, establishes SMCs for each of said aperture periods that vary among said aperture periods and map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel.

61. The circuit of claim 54, wherein said SMC generating circuit generates the SMCs for each source channel at any given time as a vector that allocates a distribution of at least a portion of the audio signal on said source channel among said target channels.

65. A circuit for reproducing on at least two target channels a multispectral band audio signal present on monaural or stereo source channels, comprising:

a receive circuit connected to read said audio signal with the signal organized into successive temporal aperture periods on said source channels, along with a set of spectral mapping coefficients (SMCs) for each of said aperture periods that, for each band of each source channel, vary among said aperture periods and map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels, and

a decoding circuit connected to apply said SMCs to said audio signal on said source channels to obtain the

audio signal on said target channels.

67. The circuit of claim 65, for SMCs for each source channel in the form of respective vectors that at any given time allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said receive circuit is connected to read said SMCs in the form of said vectors, and said decoding circuit derives said SMCs from said vectors for application to said audio signal on said source channels.

Add new claims 86-121:

86. An encoded digital audio medium, comprising:

a digital audio storage medium have a first set of digital signal channels,

a digitally encoded audio signal stored on said first set of channels and organized into successive temporal aperture periods, and

for each channel in said first set, a set of mapping coefficients for each of said aperture periods stored on said medium in the form of digitally encoded signals that vary among said aperture periods and map audio signal levels on said channel onto desired signal levels for each channel in a second channel set.

87. The digital audio medium of claim 86, wherein said audio signal on said first set of channels comprises multiple spectral bands, with mapping coefficients for each of said spectral bands.

88. The digital audio medium of claim 86, wherein said audio signal comprises a series of multibit words, and

said coefficients comprise lower order bits of said words.

89. The digital audio medium of claim 88, where said coefficients comprise the least significant bit of a fractional number of said words.

90. The digital audio medium of claim 86, wherein the mapping coefficients for each of said first set of channels at any given time define a vector that allocates a distribution of at least a portion of the signal on said channel among the channels of the second set.

91. The digital audio medium of claim 90, wherein the distribution of the signals on said first set of channels among said second set of channels is partially predetermined and partially allocated by said vectors.

92. The digital audio medium of claim 91, wherein the predetermined portions of the signal distributions are distributed equally among said second set of channels.

93. An encoded digital audio medium, comprising:

a digital audio storage medium,

a digitally encoded audio signal on monaural or stereo source channels stored on said storage medium in multiple spectral bands and organized into successive temporal aperture periods, and

spectral mapping coefficients (SMCs) stored on said storage medium for each of said aperture periods that vary among said aperture periods and, for each band of each source channel, map the signal level within said band onto desired signal levels for a corresponding spectral band of

a target channel.

94. The digital audio medium of claim 93, wherein said audio signal has a predetermined distribution among said target channels, and said SMCs represent the ratios between the signals within each spectral band of each source channel and the predetermined signal within the corresponding spectral band of each target channel.

95. The digital audio medium of claim 93, wherein said audio signal comprises a series of multibit words, and said SMCs comprise lower order bits of said words.

96. The digital audio medium of claim 95, wherein said SMCs comprise the least significant bit of a fractional number of said words.

97. The digital audio medium of claim 93, wherein said SMCs for each source channel at any given time define a vector that allocates a distribution of at least a portion of the audio signal on said channel among said target channels.

98. The digital audio medium of claim 97, wherein the distribution of the signals on said source channels among said target channels is partially predetermined and partially allocated by said vectors.

99. The digital audio medium of claim 98, wherein the predetermined portions of the signal distributions are distributed equally among said target channels.

100. The method of either of claims 1 or 15, wherein

each channel in said second set includes mapped contributions from each channel in said first set.

101. The method of either of claims 20 or 32, wherein each target channel includes mapped contributions from each source channel.

102. The circuit of either of claims 36 or 49, wherein each channel in said second set includes mapped contributions from each channel in said first set.

103. The circuit of claim 54, where each target channel includes mapped contributions from each source channel.

104. The digital audio medium of claim 86, wherein each channel in said second set includes mapped contributions from each channel in said first set.

105. The digital audio medium of claim 94, where each target channel includes mapped contributions from each source channel.

106. The method of claim 3, wherein said audio signal is spread among said first set of channels as a compressed and spectrally decomposed signal that is divided into different spectral bands on said first set of channels, with said audio signal spectral bands matching said mapping coefficient spectral bands.

107. The method of claim 17, wherein said audio signal is spread among said first set of channels as a compressed

and spectrally decomposed signal that is divided into different respective spectral bands on said channels that match said SMC bands.

108. The method of claim 20, wherein the signal on each source channel is compressed, and said SMCs are established within spectral bands that match the spectral bands of the signal on each source channel.

109. The method of claim 32, wherein the signal on each source channel is compressed and spectrally decomposed into different spectral bands, and said SMCs are provided within spectral bands that match the spectral bands of the signal on each source channel.

110. The method of any of claims 1, 15, 20 or 32, wherein successive aperture periods overlap.

111. The method of claim 110, wherein said audio signal in said aperture periods is multiplied by generally bull-shaped aperture functions for each aperture period to produce bounded signal packets for said periods.

112. The method of claim 111, wherein each successive aperture function begins at approximately the midpoint of the immediately preceding aperture period.

113. The circuit of any of claims 36, 49, 54 or 65, wherein successive aperture periods overlap.

114. The circuit of claim 113, wherein said audio signal in said aperture periods is multiplied by generally

bell-shaped aperture functions for each aperture period to produce bounded signal packets for said periods.

115. The circuit of claim 114, wherein each successive aperture function begins at approximately the midpoint of the immediately preceding aperture period.

116. The audio medium of either of claims 86 or 93, wherein successive aperture periods overlap.

117. The audio medium of claim 116, wherein said audio signal in said aperture periods is multiplied by generally bell-shaped aperture functions for each aperture period to produce bounded signal packets for said periods.

118. The audio medium of claim 117, wherein said audio signal in said aperture periods is multiplied by generally bell-shaped aperture functions for each aperture period to produce bounded signal packets for said periods.

119. The method of any of claims 1, 15, 20 or 32, wherein the coefficients for at least some successive aperture periods are the same.

120. The circuit of any of claims 36, 49, 54 or 65, wherein the coefficients for at least some successive aperture periods are the same.

121. The audio medium of either of claims 86 or 93, wherein the coefficients for at least some successive aperture periods are the same.

REMARKS

This preliminary amendment adds a requirement to all of the claims in the original parent application that the audio signal on the first set of channels be organized into successive temporal aperture periods, that the mapping coefficients be established for each of the aperture periods, and that the mapping coefficients vary among the aperture periods. New claims 86-99 are for digital storage media that bear signals encoded in accordance with selected ones of the method claims 1-35, and also include the successive temporal aperture period requirements; they correspond to claims 86-87, 89-95 and 97-101 that were added in the amendment filed on July 6, 1998 in the parent application. New claims 100-109 correspond to claims 112-125 added in the preliminary amendment filed May 11, 1999 in the parent CPA and require that each channel in the second set of channels include a mapped contribution from each channel in the first set (see page 4, lines 31-35 for support). New claims 110, 113 and 116 are dependent claims which add a requirement that the successive aperture periods overlap, new claims 111, 114 and 117 are dependent claims requiring that the audio signal in the aperture periods be multiplied by generally bell-shaped aperture functions for each aperture period to produce bounded signal packets for said periods, while new claims 112, 115 and 118 are dependent claims requiring that each successive aperture function begins at approximately the midpoint of the immediately preceding aperture period. New claims 119-121 are dependent claims addressed to the option of having the mapping coefficients for at least some successive aperture periods be the same.

Organizing the input audio signal into successive

aperture periods, with the mapping coefficients varying among the aperture periods, is disclosed in the specification at page 2, lines 29-32; page 3, lines 12-14; page 7, lines 7-16; page 7, line 29 - page 8, line 5; page 8, line 35 - page 9, line 6; page 9, lines 25-34; and page 12, lines 22-33; and is illustrated in FIG. 3. This contrasts with anything that might be analogized to a mapping coefficient in the references cited in the parent application, in which the mapping coefficients are static and simply map input channels onto output channels in a constant fashion without regard to the audio signal at any point in time. Applicant's time varying mapping coefficients, on the other hand, allow for the multichannel distribution of the audio signal to be under the complete control of the encoder (page 3, lines 12-17). This allows for effects such as changing the direction from which various sounds appear to come in surround sound systems.

The overlapping nature of the aperture periods in the preferred embodiment is illustrated in FIG. 3 and described in the specification at page 8, lines 6-25. The related features of multiplying the audio signal by generally bell-shaped aperture functions to produce bounded signal packets for the periods, and each successive aperture function beginning at approximately the midpoint of the immediately preceding aperture period, are disclosed respectively at page 8, lines 9-13 and page 8, lines 18-20. While the mapping coefficients in general dynamically vary among the aperture periods, in certain application the coefficients for at least some successive aperture periods can be the same, as claimed in new claims 119-121 (page 8, lines 4-5 and page 12, lines 22-33).

Since the claims as amended patentably distinguish over the prior art, a Notice of Allowance is respectfully requested.

Respectfully submitted,

June 25, 2001

Richard S. Koppel
Registration No. 26,475
Attorney for Applicant

KOPPEL & JACOBS
555 St. Charles Drive, Suite 107
Thousand Oaks, California, 91360
(805) 373-0060

M/D2-115-21-099prelim.amd

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Title

MULTICHANNEL SPECTRAL MAPPING AUDIO APPARATUS AND METHOD WITH DYNAMICALLY VARYING MAPPING COEFFICIENTS

Specification

Page 1, first line following this title:

RELATED APPLICATION

This is a continuation of application Serial No. 08/715,085, filed September 19, 1996 by the present inventor, entitled "Multichannel Spectral Mapping Audio Apparatus and Method".

Claims

1. (Amended) A method of conditioning an audio signal on a first set of channels to be reconfigured onto a second set of channels, comprising:

organizing said signal on said first set of channels into successive temporal aperture periods,

for each channel in said first set, establishing mapping coefficients for each of said aperture periods in the form of digitally encoded signals that vary among said aperture periods and map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

storing said audio signal on said first set of channels along with said mapping coefficient signals on a digital medium from which both the first set of channels and the coefficients can be read.

10. (Amended) The method of claim 1, wherein the mapping coefficients for each of said first set of channels at any given time define a vector that allocates a distribution of at

least a portion of the signal on said channel among the channels of the second set.

15. (Amended) A method of reproducing on a second set of channels an audio signal present on a first set of channels, comprising:

organizing said signal on said first set of channels into successive temporal aperture periods,

providing said audio signal in digital format on said first set of channels along with a set of digitally formatted mapping coefficients for each of said aperture periods that vary among said aperture periods and, for each channel in said first set, map the audio signal level of said channel onto respective channels of said second set of channels,

reading said audio signal on said first set of channels and said coefficients, and

applying said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

18. (Amended) The method of claim 15, wherein the mapping coefficients for each of said first set of channels at any given time are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, said coefficients are read from said digital medium in the form of said vectors, and the coefficients that are applied to said audio signal on said first set of channels to obtain the audio signal on said second set of channels are derived from said vectors.

20. (Amended) A method of conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format of target channels, comprising:

organizing said signal on said source channels into successive temporal aperture periods,

dividing the signal on each source channel into multiple spectral bands,

establishing spectral mapping coefficients (SMCs) for each of said aperture periods that vary among said aperture periods and, for each band of each source channel, map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel, and

storing said audio signal on said source channels along with said SMCs on a digital medium from which both the source channels and the SMCs can be read.

27. (Amended) The method of claim 20, wherein said SMCs for each source channel at any given time define a vector that allocates a distribution of at least a portion of the audio signal on said channel among said target channels.

32. (Amended) A method of reproducing on two or more target channels an audio signal present on monaural or stereo source channels, comprising:

organizing said signal on said source channels into successive temporal aperture periods,

providing said audio signal in digital format on said source channels along with a set of spectral mapping coefficients (SMCs) for each of said aperture periods that vary among said aperture periods and, for each band of each source channel, map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels,

reading said audio signal on said source channels and said SMCs, and

applying said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

34. (Amended) The method of claim 32, for SMCs for each source channel that at any given time are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said SMCs are read from said digital medium in the form of said vectors, and the SMCs that are applied to said audio signal on said source channels to obtain the audio signal on said target channels are derived from said vectors.

36. (Amended) An audio signal conditioning circuit for conditioning an audio signal on a first set of channels to be configured onto a second set of channels, comprising:

a signal processor that organizes an audio signal on said first set of channels into successive temporal aperture periods,

a mapping coefficient generating circuit that, for each channel in said first set, establishes mapping coefficients for each of said aperture periods in the form of digitally encoded signals that vary among said aperture periods and map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

a transfer circuit connected to apply said audio signal on said first set of channels along with said mapping coefficient signals to a digital medium.

45. (Amended) The circuit of claim 36, wherein said coefficient generating circuit generates the coefficients for each of said first set of channels at any given time as a vector that allocates a distribution of at least a portion of

the signal on said channel among the channels of the second set.

49. (Amended) A circuit for reproducing on a second set of channels an audio signal present on a first set of channels, comprising:

a receive circuit connected to read said audio signal organized into successive temporal aperture periods on said first set of channels along with a set of mapping coefficients [from] for each of said aperture periods that, for each channel in said first set, vary among said aperture periods and map the audio signal level of said channel onto respective channels of said second set of channels, and

a decoding circuit connected to apply said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

52. (Amended) The circuit of claim 49, for coefficients for each of said first set of channels in the form of respective vectors that at any given time allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, wherein said receive circuit is connected to read said coefficients in the form of said vectors, and said decoding circuit derives said coefficients from said vectors for application to said audio signal on said first set of channels.

54. (Amended) An audio signal conditioning circuit for conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format having at least two target channels, comprising:

a spectral decomposition circuit connected to divide the signal on each source channel into multiple spectral bands, [and]

a signal processor that organizes the signals on said multiple spectral bands into successive temporal aperture periods, and

a spectral mapping coefficient (SMC) generating circuit that, for each band of each source channel, establishes SMCs for each of said aperture periods that vary among said aperture periods and map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel.

61. (Amended) The circuit of claim 54, wherein said SMC generating circuit generates the SMCs for each source channel at any given time as a vector that allocates a distribution of at least a portion of the audio signal on said source channel among said target channels.

65. (Amended) A circuit for reproducing on at least two target channels a multispectral band audio signal present on monaural or stereo source channels, comprising:

a receive circuit connected to read said audio signal, with the signal organized into successive temporal aperture periods on said source channels, along with a set of spectral mapping coefficients (SMCs) for each of said aperture periods that, for each band of each source channel, vary among said aperture periods and map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels, and

a decoding circuit connected to apply said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

67. (Amended) The circuit of claim 65, for SMCs for each source channel in the form of respective vectors that <ins>at any given time</ins> allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said receive circuit is connected to read said SMCs in the form of said vectors, and said decoding circuit derives said SMCs from said vectors for application to said audio signal on said source channels.